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* F. C. Dahl T100			This document provides the procedures for performing the final radiological survey of Building T011, formerly known as the "Radiation Instrument Calibration Laboratory". The scope of this survey is limited to the northern section of the building only. The southern section of the building is an unrelated warehouse facility, not used in any way for radiological work, and is therefore excluded. This survey will ensure that all areas of Building T011 will meet all NRC, DOE and State of California criteria for release of the facility for unrestricted use.		
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CONTENTS

1. INTRODUCTION	4
1.1 Building History	4
2. SAMPLING PLAN OVERVIEW	5
2.1.1 Walls, Floors and Ceiling	5
2.1.2 Structural Surfaces	6
2.1.3 Concrete Pads	6
2.1.4 Sink Traps	6
2.1.5 Roofs	6
2.2 Instrument Calibrations and Checks	6
2.3 General Survey Procedures	7
3. REFERENCES	8
4. SPECIAL EQUIPMENT/MATERIALS	9
4.1 Equipment	9
4.2 Materials	9
4.3 Special Instrumentation Instructions	9
5. GENERAL REQUIREMENTS	10
5.1 Safety Precautions Special Instructions	10
5.1.1 General Health and Safety Instructions	10
5.2 Limits	10
5.2.1 Surface Contamination Limits for Alpha and Beta-Gamma Emitters	10
5.2.2 Ambient Gamma Exposure Rate Limits	11
5.3 Prerequisites	11
5.4 Sequence of Activities	12
6. DETAILED SAMPLING PROCEDURE	13
6.1 Sample Lot Survey Procedure (Sample Lot 1 - Affected Areas)	13
6.1.1 Sample Lot Gridding	13
6.1.2 Alpha Average Contamination Measurements	13
6.1.3 Alpha Maximum Contamination Measurements	14
6.1.4 Beta Average Contamination Measurements	14
6.1.5 Beta Maximum Contamination Measurements	15
6.1.6 Alpha and Beta Removable Contamination Measurements	15
6.1.7 Sample Lot Repeated Measurement	15
6.1.8 Gamma Ambient Exposure Rate Measurements	16
6.1.9 Survey Records	16
6.2 Sample Lot Survey Procedure (Sample Lot 2 - Unaffected Areas)	16

6.2.1 Sample Lot Gridding	16
6.2.2 Alpha Average Contamination Measurements	17
6.2.3 Alpha Maximum Contamination Measurements	17
6.2.4 Beta Average Contamination Measurements	18
6.2.5 Beta Maximum Contamination Measurements	18
6.2.6 Alpha and Beta Removable Contamination Measurements	19
6.2.7 Sample Lot Repeated Measurement	19
6.2.8 Gamma Ambient Exposure Rate Measurements	19
6.2.9 Sink Traps	19
6.2.10 Survey Records	20
7. COMPLETION REVIEW AND APPROVAL	21

FIGURES

Figure 1. T011 Sample Lot Locations	22
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APPENDICES

Appendix A Final Survey Data Sheet	23
Appendix B Building T011 Survey Training Requirements	24
Appendix C Document Sign-Off Form	25
Appendix D Alpha Instrument Qualification Data Sheet	26
Appendix E Beta Instrument Qualification Data Sheet	27
Appendix F Gamma Instrument Qualification Data Sheet	28

1. INTRODUCTION

This document provides the procedures for performing the final radiological survey of Building T011, formerly known as the "Radiation Instrument Calibration Laboratory". The scope of this survey includes a 100% direct qualitative scan for alpha and beta-gamma contamination followed by a 11% cumulative count survey of interior surfaces of "affected" areas in the north section of the building where handling of radioactive materials occurred. The remaining parts of the north section of the building are classified as "unaffected" areas and will be surveyed by a 10% qualitative scan, followed by a 2%/5% cumulative count survey. The southern portion of the building was an unrelated facility, not used in any way for radiological work, and is therefore excluded from consideration in this survey.

This survey will ensure that all areas of Building T011 will meet all NRC, DOE and State of California criteria for release of the facility for unrestricted use. The sampling inspection by variables method will be applied to the data obtained in this survey procedure. The in-house computer code "CumPlot" will be used for data analysis and presentation of survey report results.

This is a final survey procedure for a clean facility. Any areas that exceed limits of this procedure shall be decontaminated per a separate special procedure and an additional survey performed to document those areas as meeting all DOE, NRC and State of California criteria for release of a facility for unrestricted use.

1.1 Building History

The north section of the building was used for calibration and repair of radiation instrumentation over a time period from 1984 to 1996. This activity involved the regular use of radioactive sources for calibration, most of which were sealed. Work activities included the repair of radiation detection equipment which may have been contaminated when used on various decommissioning and decontamination (D&D) projects. The south section of the building was used by the Property Inventory and Control department as a general storage warehouse and has no history of storage or handling of radioactive materials.

A spot survey of several rooms in the north section was performed in March 1996 during transfer of counting equipment from the building to T100. Although the results of this spot survey indicated no observable radionuclide contamination, it was deemed prudent to perform a release radiological survey of the north section to verify that no residual contamination exists from unsuspected causes. The primary nuclides of interest during this survey will be Cs-137, Co-60, Sr-90, Eu-152, Eu-154, thorium, and uranium.

2. SAMPLING PLAN OVERVIEW

The final radiological survey of Building T011 requires a series of specific steps in the sample lots to be surveyed. Distinguishable properties for selecting the sampling lots are rooms in Building T011 where there was known, or suspected, use or presence of radioactive materials. The areas included in the sampling lots are listed below (see Figure 1 for location of rooms in T011):

Sample Lot 1 (Affected Areas): Rooms 100, 102, 104, 105, 106, 108, 111, and adjacent hallways.

Sample Lot 2 (Unaffected Areas): Rooms 101, 103, 118, 120, 121, 122, 124, and adjacent hallways.

If contamination or high ambient radiation above 25% of release guidelines is found in any areas from Sample Lot 2, those areas will be re-classified as “affected”, and surveyed at a 100% level. If necessary, a procedure will be written to decontaminate any rooms with contamination exceeding allowable limits, and document the findings. And such rooms will be re-surveyed to the limits prescribed in this procedure.

2.1.1 Walls, Floors and Ceiling

For affected areas, direct qualitative scan of 100% of the floor, walls, and ceiling shall be conducted. Following the scan, a uniform 3-m x 3-m grid shall be laid out on the floor, ceiling and walls, starting in one room at the northwest corner. One 1-m x 1-m area within each 3-m x 3-m grid shall be selected for a cumulative count survey. A minimum of 30 data points shall be selected in each sample lot. For surfaces having areas less than 1-m x 1-m, a minimum area of 1-m x 1-m shall be surveyed by combining the other adjacent remnant areas.

For affected areas, additional surveying will be conducted underneath selected floor tiles in each room or area. The floor tiles in T011 are older type 9-in. x 9-in. tiles which have been shown to contain sufficient levels of asbestos to be classified as Asbestos Containing Material (ACM). Typically, the floor mastic used to attached these tiles is also classified as ACM. The floor tiles will be randomly selected, or chosen from areas where tiles have already been removed or are only loosely adhered to the sub-floor due to years of exposure and moisture leakage. Removal of tiles which remain firmly adhered to the sub-floor will be conducted as needed by trained asbestos abatement personnel. It is probable that areas where the tiles have already been removed, or are only loosely adhered, are areas where potential contamination would be more likely to exist.

For unaffected areas, a direct qualitative scan of 10% of the floors, walls, and ceilings shall be conducted. Areas of particular concern should include floor baseboards, window sills, areas behind file cabinets or other furniture, door thresholds, and any other areas where contamination

would be likely to have accumulated over time. Following the surface scan, a uniform 3-m x 3-m grid shall be laid out on the floors, wall, and ceilings, as described above. Randomly select one 1-m x 1-m grid floor and wall grid within every two 3-m x 3-m grids (approximately 5%), and one 1-m x 1-m ceiling grid within every five 3-m x 3-m (approximately 2%), for cumulative count survey. A minimum of one data point for every 50 m² shall be obtained.

2.1.2 Structural Surfaces

Structural surfaces consist of beams, pipes, conduits, and other surfaces that are not amenable to large surface measurements. Twenty percent of the structural surfaces shall be surveyed for affected areas, and 10% for unaffected areas. The selection of surfaces to survey should be biased toward those expected to have the highest contamination levels (e.g. ledges, tops of conduit, etc.).

2.1.3 Concrete Pads

Concrete pads shall be surveyed as a floor area in the same manner as indicated in Section 2.1.1.

2.1.4 Sink Traps

Sink traps located in the unaffected areas shall be sampled for potential contamination. This sampling shall include a 100% scan on the outside of the trap (including gamma radiation), a smear survey inside the trap, and if possible, sludge collection for gamma spectroscopy analyses from the inside bottom of the trap.

2.1.5 Roofs

Heating and air conditioning systems for the north section of T011 are located on the roof of the building. Return air ducts in both affected and unaffected areas of T011 will be surveyed for possible contamination. If no contamination is found, the roof of the facility will be deemed clean. If contamination is found, this procedure will be red-lined indicating additional survey steps required. If contamination is found above release limits, the registers will be decontaminated and resurveyed per Section 1.

2.2 Instrument Calibrations and Checks

Measurements of the average and maximum alpha surface activities shall be made with alpha scintillation detectors, sensitive only to alpha particles with energies exceeding about 1.5 MeV. The detectors shall be calibrated with a Th-230 alpha source standard. Measurements of the average and maximum beta surface activities shall be made with a thin-window pancake Geiger-Mueller tube. The detectors shall be calibrated with a Tc-99 beta source standard.

All portable survey instruments shall be serviced and calibrated on a quarterly basis. Daily checks and calibrations shall be performed on all instrumentation (when used) to determine

Table 1. Summary of Gamma Spectrometry Data for All 199 T009 Drain Line Soil Samples

Radionuclide	Mean Value ^a (pCi/g)	Standard Deviation ^b (pCi/g)
<u>Naturally occurring</u>		
²³⁸ U	0.64	0.24
²³⁵ U	0.02	0.03
²³² Th	0.97	0.36
⁴⁰ K	15.3	5.6
<u>Man-made</u>		
¹³⁷ Cs	0.0 ^c	0.0
¹³⁴ Cs	0.0	0.0
⁶⁰ Co	0.0	0.0

^aMean value of 199 soil data values (Appendix A).

^bStandard deviation (1 σ) of distribution.

^cMean value includes two data points with values of 0.15 and 0.18 pCi/g, which were above the cutoff limit for the measuring equipment (see text).

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3.3 COMPARISON WITH BACKGROUND RADIONUCLIDE ACTIVITY LEVELS AT THE SSFL

Because radionuclide activity, including the fission product ¹³⁷Cs, was observed in the inactive SGR hold-up tank sludge sample, it is instructive to examine the radionuclide data in Table 1 to determine if the measured activities are consistent with naturally occurring radioactivity levels at the SSFL. This will verify that no unobserved leaks occurred in the drain line system during its operation that may have contaminated the surrounding soil.

Background radionuclide activity is present at the SSFL, and elsewhere, as a result of several naturally occurring radionuclides and also from the man-made nuclide ¹³⁷Cs from radioactive fallout during the period of atmospheric nuclear weapons testing. Background values for radionuclide activity at the SSFL were independently measured as part of an Area IV survey by Groundwater Resources Consultants (GRC), Inc. between July and October 1988 (Ref. 6). Measured background values for ²³⁸U, ²³⁵U, ²³²Th, ¹³⁷Cs, and ⁴⁰K from the survey are summarized in Table 2. The activity values in Table 2 are an average of data from three representative soil samples taken during the GRC survey.

Comparing the data in Tables 1 and 2 indicates that in each case the radionuclide values measured in the Building T009 soil are consistent although somewhat lower than the corresponding GRC values. The zero average ^{137}Cs value for the T009 soil samples in Table 1 may be attributed to that fact that the soil was taken from around the buried drain lines, and thus was underground and largely unaffected from any fallout. The measured ratio of ^{235}U to ^{238}U in the drain line soil is also consistent, within uncertainties, with the GRC measured ratio, and the expected naturally occurring activity ratio of 0.045 (Ref. 7) for these two isotopes.

Thus, the data show no increased residual activity either from the ^{137}Cs fission product, from the ^{238}U and ^{235}U fuel element isotopes, or from ^{232}Th , which could have potentially contaminated the soil in the vicinity of the drain lines.

Although the comparison of the data in Tables 1 and 2 indicates that there is no residual radionuclide activity from ^{137}Cs , ^{238}U , or ^{235}U in the Building T009 drain line soil, the data do indicate some small systematic differences in the T009 data and the corresponding background data determined by GRC. Figures 2, 3, and 4 show the ratio of ^{238}U , ^{232}Th , and ^{235}U with respect to the naturally occurring ^{40}K data, for each of the 199 soil samples plotted against the cumulative gaussian probability. The value of this type of graphical display is that it permits the identification of individual data points significantly outside the range expected for the distribution. For a perfectly "normal" (gaussian) distribution, the data values would fall on a straight line, with the mean value

Table 2. Summary of Background Soil Radionuclide Activity at the SSFL

Isotope	Mean Value ^a (pCi/g)	Standard Deviation ^b (pCig)
<u>Naturally occurring</u>		
^{238}U	1.1	0.3
^{235}U	0.04	0.02
^{232}Th	1.7	0.3
^{40}K	22	1
<u>Man-made</u>		
^{137}Cs	0.07	0.05

Note: Data from Groundwater Resources Consultants (GRC) Report 8640M-77 (Ref. 6)

^aAverage of data from three representative soil samples.

^bStandard deviation (1 σ) of distribution.

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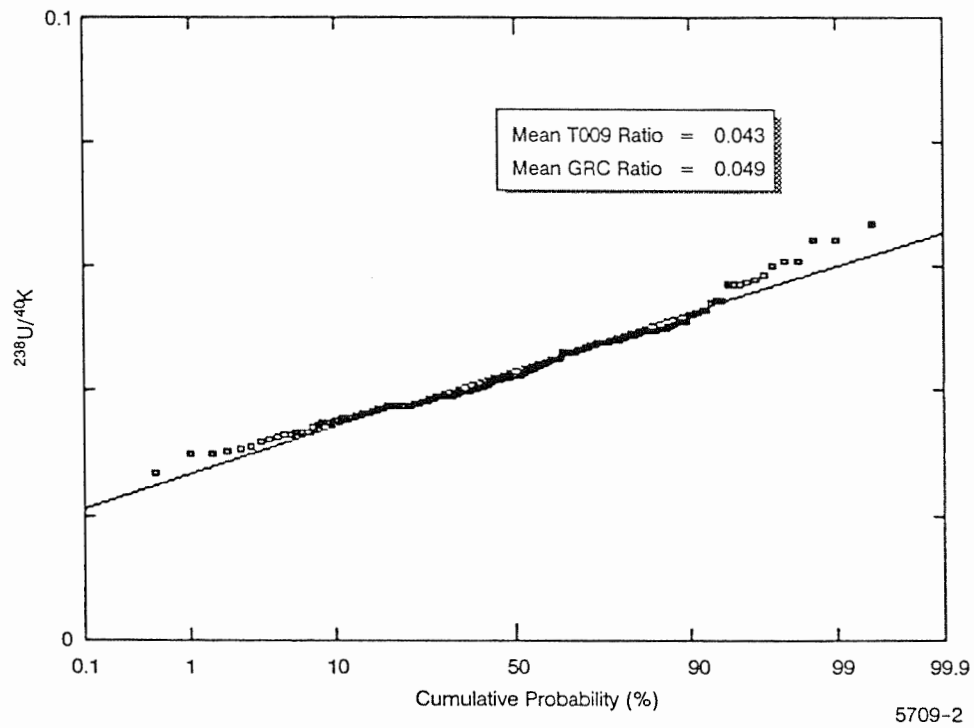


Figure 2. Measured $^{238}\text{U}/^{40}\text{K}$ Ratio in T009 Drain Line Soil

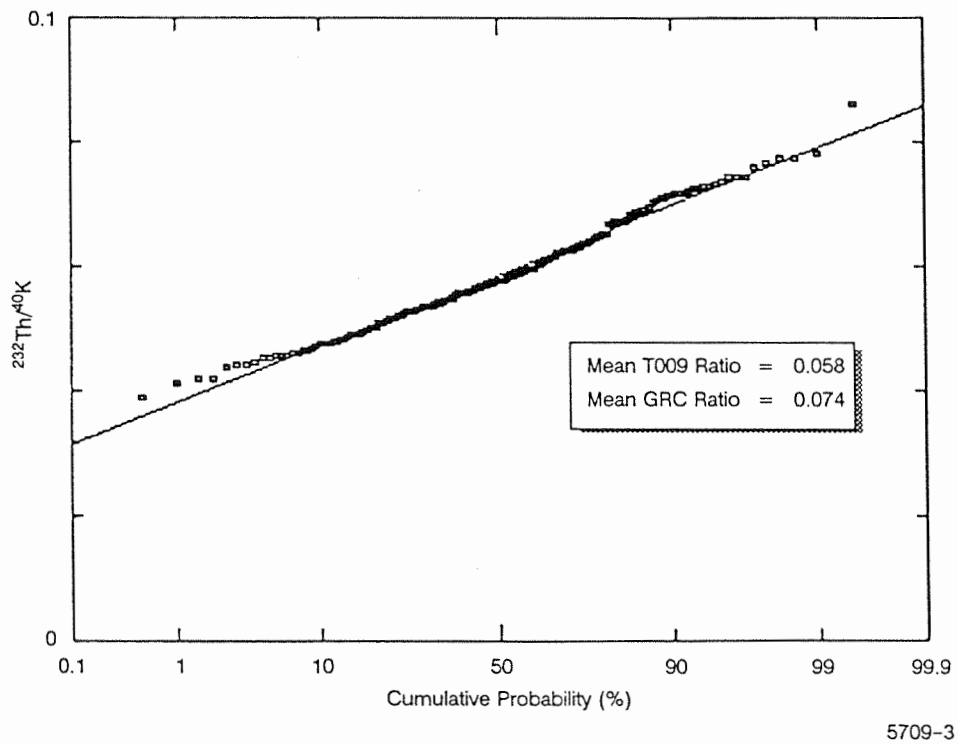
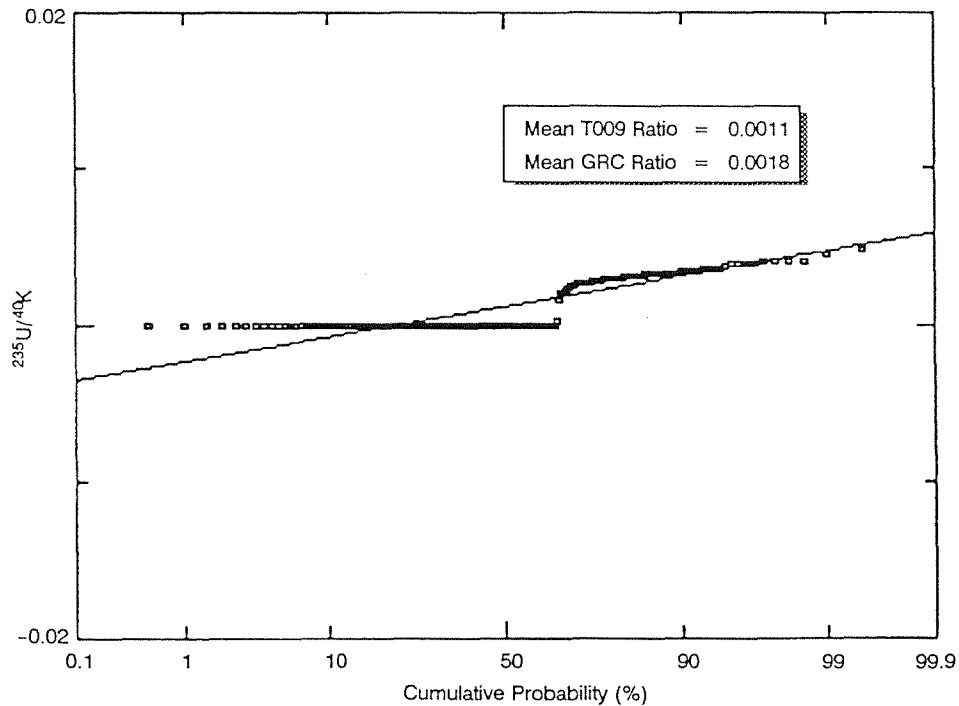


Figure 3. Measured $^{232}\text{Th}/^{40}\text{K}$ Ratio in T009 Drain Line Soil



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Figure 4. Measured $^{235}\text{U}/^{40}\text{K}$ Ratio in T009 Drain Line Soil

occurring at the 50% point on the probability axis. For comparison, the mean ratio values for the T009 data and the GRC data are also indicated inside each figure.

Figures 2 and 3 show distributions which are closely gaussian, with no outliers. The distribution in Figure 4, for ^{235}U , also shows no outliers but it is slightly skewed due to a large number of “zero” measurements. The mean isotope ratios obtained from the Building T009 data, although being similar to the corresponding GRC values, are nonetheless consistently lower. These comparisons, therefore, suggest that there are some small energy-dependent sensitivity and/or calibration differences between the Canberra instrument used at the SSFL and the analysis system used by GRC Inc. These differences, however, have no effect on the overall conclusions reached from the data.

4.0 CONCLUSIONS

In accordance with the recommendations of the Building T009 radiological survey, the inactive SGR hold-up tank and associated drain line system were removed under Health Physics supervision for disposal at an authorized site. As part of this work, extensive soil samples were taken for subsequent gamma spectrometric analysis and the results were compared with background radionuclide activity levels at the SSFL. These analyses are reported here, and the following conclusions are drawn.

4.1 SPECIFIC CONCLUSIONS

1. No residual levels of man-made radionuclides were observed in the T009 drain line soil.
2. Measured naturally occurring radionuclide activity in the Building T009 drain line soil was comparable to (although slightly lower than) normal background levels measured independently in nearby soils at the SSFL.
3. The slightly lower T009 soil activity results compared to normal background levels are attributed to small variations in the sensitivity and/or calibration of the SSFL analysis system.

4.2 OVERALL CONCLUSIONS

1. Based on the results of the analyses reported here, the Building T009 drain line soil is free of any residual radioactive contamination.
2. Based on the results of the 1988 radiological survey of Building T009, the OMR side (interior western side) and the outside northwestern areas surveyed are acceptably free of residual radioactive contamination.
3. The interior western side and the exterior northwestern side are suitable for release for use without radiological restrictions.

5.0 REFERENCES

1. Chapman, J. A., "Radiological Survey of Building T009," GEN-ZR-0014, Rocketdyne Division, Energy Technology Engineering Center, Rockwell International, August 26, 1988.
2. Badger, F. H., and Tuttle, R. J., "Radiological Survey Plan for SSFL," 154SRR000001, Rocketdyne Division, Rockwell International, September 25, 1985.
3. Klein, A., "Building T009 Drain System Removal," N001TI000329, Rocketdyne Division, Rockwell International, August 22, 1990.
4. Parker, D. C., "SGR Liquid Drain Line System Removal, Building T009," 195DWP000001, Rocketdyne Division, Rockwell International, October 10, 1989.
5. Chapman, J. A., "Radiological Survey of the Source and Special Nuclear Material Storage Vault - Bldg T64," GEN-ZR-0005, Energy Technology Engineering Center, Rockwell International, August 19, 1988.
6. "Investigation of Naturally Occurring Radionuclides in Rock, Soils and Groundwater - Santa Susana Field Laboratory, Ventura County, California," 8640M-77, Groundwater Resources Consultants, Inc., June 1, 1990.
7. Lederer, C. M. and Shirley, V. S. (Eds.), "Table of Isotopes," 7th ed., John Wiley, New York, 1978.

APPENDIX A

DERIVED ALPHA, BETA, AND RADIONUCLIDE DATA FROM BUILDING T009 DRAIN LINE SOIL

During removal of the SGR hold-up tank and associated drain line system from Building T009, 199 two-pound samples were collected from the soil surrounding the drain lines. In each case, samples ranging in mass from ~700 to 900 g were analyzed using a Canberra system as described in Ref. 2. Following analysis, the results were input to the MCASOIL spreadsheet, which calculated derived quantities for total alpha and total beta, and derived activities for selected man-made and naturally occurring radionuclides. A zero value in the data tables indicates that no photopeaks were detected above the detection limit of the Canberra multichannel analyzer. For ^{137}Cs , this detection limit was ~0.1 to 0.2 pCi/g for the counting times used for the analyses.

Table A-1. Gamma Spectrometry Data from Drain Line Soil Samples
(Sheet 1 of 6)

	39	40	41	42	43	44	45	46	47	48	49	50
1	BUILDING T009 DRAIN LINE SOIL SAMPLES											
2	(Samples Analyzed: 1/11/90 TO 1/18/90)											
3	Excel File: 009SOIL.XLS											
4												
5												
6												
7												
8												
9												
10												
11												
12												
13												
14	SOIL 1	708.2	0.74	1.11	0.04	0.03	16.50	0.00	0.00	0.00	12.88	25.58
15	SOIL 2	584.9	0.63	1.15	0.00	0.03	16.76	0.00	0.00	0.00	11.89	25.14
16	SOIL 3	494.8	0.73	1.13	0.00	0.03	19.48	0.00	0.00	0.00	12.59	28.39
17	SOIL 4	630.4	0.65	1.09	0.00	0.03	17.39	0.00	0.00	0.00	11.75	25.69
18	SOIL 4 DUPLICATE	698.0	0.67	0.79	0.04	0.03	13.85	0.00	0.00	0.00	10.41	21.24
19	SOIL 5	659.2	0.67	1.05	0.00	0.03	18.31	0.00	0.00	0.00	11.62	26.53
20	SOIL 6	649.4	0.84	1.06	0.05	0.04	17.01	0.00	0.00	0.00	13.48	26.56
21	SOIL 7	628.7	0.87	1.09	0.06	0.04	17.57	0.00	0.00	0.00	13.93	27.44
22	SOIL 8	659.1	0.62	1.19	0.00	0.03	16.34	0.00	0.00	0.00	12.11	24.85
23	SOIL 9	639.4	0.69	1.07	0.00	0.03	16.50	0.00	0.00	0.00	11.92	24.93
24	SOIL 10	670.1	0.73	0.74	0.04	0.03	17.68	0.00	0.00	0.00	10.60	25.24
25	SOIL 11	776.4	0.53	0.74	0.00	0.02	14.19	0.00	0.00	0.00	8.64	20.32
26	SOIL 12	699.7	0.71	0.95	0.00	0.03	16.10	0.00	0.00	0.00	11.34	24.17
27	SOIL 12 DUPLICATE	716.1	0.55	0.87	0.00	0.02	15.08	0.00	0.00	0.00	9.65	21.91
28	SOIL 13	717.0	0.74	0.98	0.05	0.03	15.41	0.00	0.00	0.00	12.15	24.00
29	SOIL 14	724.7	0.59	0.89	0.00	0.03	16.69	0.00	0.00	0.00	10.08	23.84
30	SOIL 15	739.9	0.55	0.97	0.00	0.02	14.48	0.00	0.00	0.00	10.28	21.73
31	SOIL 16	627.4	0.97	1.10	0.00	0.04	16.77	0.00	0.00	0.00	14.32	27.00
32	SOIL 17	558.4	1.01	1.01	0.07	0.05	17.71	0.00	0.00	0.00	14.57	28.09
33	SOIL 18	665.7	0.62	1.07	0.00	0.03	16.51	0.00	0.00	0.00	11.37	24.53
34	SOIL 19	730.3	0.58	0.75	0.00	0.03	13.39	0.00	0.00	0.00	9.18	19.92
35	SOIL 30	741.5	0.82	0.82	0.05	0.04	15.16	0.00	0.00	0.00	11.79	23.57
36	SOIL 31	785.2	0.62	0.81	0.00	0.03	13.89	0.00	0.00	0.00	9.85	20.91

Table A-1. Gamma Spectrometry Data from Drain Line Soil Samples
(Sheet 2 of 6)

	39	40	41	42	43	44	45	46	47	48	49	50
37	SOIL 32	782.7	0.73	0.81	0.06	0.03	15.14	0.00	0.00	0.00	11.15	23.05
38	SOIL 33	785.8	0.57	0.80	0.00	0.03	13.81	0.00	0.00	0.00	9.35	20.45
39	SOIL 34	726.3	0.48	0.69	0.00	0.02	14.68	0.00	0.00	0.00	7.95	20.32
40	SOIL 35	724.2	0.58	0.79	0.00	0.03	14.64	0.00	0.00	0.00	9.36	21.30
41	SOIL 36	691.3	0.49	0.79	0.00	0.02	14.14	0.00	0.00	0.00	8.62	20.23
42	SOIL 37	772.7	0.54	0.71	0.00	0.02	13.33	0.00	0.00	0.00	8.56	19.42
43	SOIL 38	725.2	0.56	0.89	0.00	0.03	14.97	0.00	0.00	0.00	9.77	21.88
44	SOIL 39	728.9	0.64	0.70	0.00	0.03	14.97	0.00	0.00	0.00	9.29	21.62
45	SOIL 40	738.9	0.70	0.77	0.05	0.03	14.50	0.00	0.00	0.00	10.65	22.06
46	SOIL 41	713.5	0.65	0.63	0.00	0.03	14.98	0.00	0.00	0.00	8.99	21.43
47	SOIL 52	819.6	0.71	1.04	0.04	0.03	14.97	0.00	0.00	0.00	12.18	23.57
48	SOIL 53	704.9	0.59	1.16	0.00	0.03	16.87	0.00	0.00	0.00	11.70	25.09
49	SOIL 54	761.1	0.58	0.86	0.00	0.03	15.59	0.00	0.00	0.00	9.85	22.58
50	SOIL 55	661.3	0.66	1.01	0.00	0.03	15.71	0.00	0.00	0.00	11.34	23.74
51	SOIL 56	776.0	0.68	1.09	0.04	0.03	15.05	0.00	0.00	0.00	12.24	23.66
52	SOIL 57	818.2	0.92	1.11	0.04	0.04	15.28	0.00	0.00	0.00	14.25	25.41
53	SOIL 58	677.2	0.76	1.06	0.04	0.03	15.80	0.00	0.00	0.00	12.67	24.76
54	SOIL 58 DUPLICATE	693.2	0.58	1.03	0.00	0.03	13.80	0.00	0.00	0.00	10.83	21.44
55	SOIL 59A	640.8	0.90	1.15	0.06	0.04	15.79	0.00	0.00	0.00	14.52	26.07
56	SOIL 60A	808.6	0.60	0.99	0.04	0.03	15.09	0.00	0.00	0.00	11.00	22.83
57	SOIL 62	705.4	0.55	0.84	0.00	0.02	18.43	0.00	0.00	0.00	9.44	25.11
58	SOIL 63	739.0	0.67	1.01	0.00	0.03	14.29	0.00	0.00	0.00	11.42	22.38
59	SOIL 64	690.5	0.73	0.79	0.05	0.03	15.79	0.00	0.00	0.00	10.89	23.54
60	SOIL 65	752.3	0.67	0.87	0.04	0.03	17.03	0.00	0.00	0.00	10.83	24.70
61	SOIL 70	613.0	0.66	1.09	0.00	0.03	17.37	0.00	0.00	0.00	11.80	25.71
62	SOIL 71	678.5	0.81	0.87	0.05	0.04	16.89	0.00	0.00	0.00	12.05	25.47
63	SOIL 72	665.2	0.70	1.00	0.00	0.03	17.03	0.00	0.00	0.00	11.60	25.26
64	SOIL 73	650.7	0.68	0.94	0.00	0.03	16.81	0.00	0.00	0.00	11.07	24.67
65	SOIL 74	774.0	0.52	0.82	0.00	0.02	15.02	0.00	0.00	0.00	9.12	21.47
66	SOIL 75	710.0	0.58	0.96	0.00	0.03	17.55	0.00	0.00	0.00	10.44	24.93
67	SOIL 76	679.5	0.92	1.18	0.06	0.04	13.73	0.00	0.00	0.00	14.85	24.24
68	SOIL 77	717.9	0.71	1.13	0.05	0.03	15.17	0.00	0.00	0.00	12.82	24.19
69	SOIL 78	612.4	0.80	1.09	0.06	0.04	17.41	0.00	0.00	0.00	13.37	26.85
70	SOIL 79	636.1	0.88	1.03	0.05	0.04	17.70	0.00	0.00	0.00	13.64	27.38
71	SOIL 80	771.2	0.57	0.73	0.00	0.03	15.14	0.00	0.00	0.00	8.93	21.50
72	SOIL 80 DUPLICATE	641.3	0.74	1.18	0.06	0.03	18.46	0.00	0.00	0.00	13.35	27.85

Table A-1. Gamma Spectrometry Data from Drain Line Soil Samples
(Sheet 3 of 6)

	39	40	41	42	43	44	45	46	47	48	49	50
73 SOIL 81		792.7	0.61	0.76	0.00	0.03	14.42	0.00	0.00	0.00	9.46	21.17
74 SOIL 82		811.9	0.54	0.68	0.00	0.02	14.62	0.00	0.00	0.00	8.43	20.63
75 SOIL 83		789.6	0.61	0.68	0.00	0.03	14.55	0.00	0.00	0.00	8.95	20.95
76 SOIL 84		774.1	0.57	0.81	0.00	0.03	13.97	0.00	0.00	0.00	9.41	20.65
77 SOIL 85		800.7	0.69	0.66	0.05	0.03	14.58	0.00	0.00	0.00	9.81	21.59
78 SOIL 86		804.3	0.58	0.80	0.00	0.03	14.32	0.00	0.00	0.00	9.45	21.03
79 SOIL 87		815.7	0.63	0.84	0.00	0.03	14.91	0.00	0.00	0.00	10.14	22.12
80 SOIL 88		823.2	0.55	0.73	0.00	0.02	14.22	0.00	0.00	0.00	8.77	20.46
81 SOIL 89		792.0	0.56	0.92	0.00	0.03	15.36	0.00	0.00	0.00	9.95	22.39
82 SOIL 90		778.8	0.82	0.77	0.06	0.04	14.04	0.00	0.00	0.00	11.60	22.32
83 SOIL 91		782.6	0.41	0.81	0.00	0.02	15.08	0.00	0.00	0.00	8.11	20.77
84 SOIL 99		772.4	0.48	0.72	0.00	0.02	15.75	0.00	0.00	0.00	8.15	21.52
85 SOIL 100		603.9	0.60	0.97	0.00	0.03	15.89	0.00	0.00	0.00	10.60	23.38
86 SOIL 101		717.4	0.45	0.73	0.00	0.02	13.43	0.00	0.00	0.00	7.97	19.06
87 SOIL 102		736.9	0.53	0.90	0.00	0.02	14.33	0.00	0.00	0.00	9.64	21.13
88 SOIL 103		776.0	0.62	0.55	0.00	0.03	11.32	0.00	0.00	0.00	8.26	17.26
89 SOIL 104		766.2	0.62	0.76	0.04	0.03	13.90	0.00	0.00	0.00	9.80	20.85
90 SOIL 105		725.2	0.49	0.78	0.00	0.02	13.24	0.00	0.00	0.00	8.58	19.31
91 SOIL 106		624.8	0.80	0.81	0.06	0.04	15.67	0.00	0.00	0.00	11.71	24.01
92 SOIL 120		816.1	0.49	0.77	0.00	0.02	14.81	0.00	0.00	0.00	8.49	20.81
93 SOIL 121		765.9	0.54	0.81	0.00	0.02	14.47	0.00	0.00	0.00	9.19	20.99
94 SOIL 122		797.2	0.59	0.92	0.00	0.03	13.55	0.00	0.00	0.00	10.21	20.77
95 SOIL 123		736.6	0.58	0.96	0.03	0.03	13.94	0.00	0.00	0.00	10.65	21.43
96 SOIL 124		774.7	0.54	0.81	0.00	0.02	11.40	0.15	0.00	0.00	9.20	18.07
97 SOIL 125		774.0	0.63	0.85	0.00	0.03	13.58	0.00	0.00	0.00	10.10	20.76
98 SOIL 126		779.9	0.51	0.79	0.00	0.02	10.28	0.00	0.00	0.00	8.85	16.54
99 SOIL 150		698.9	0.52	0.96	0.00	0.02	15.73	0.00	0.00	0.00	9.90	22.69
100 SOIL 151		623.2	0.76	1.10	0.05	0.03	16.34	0.00	0.00	0.00	13.02	25.52
101 SOIL 152		672.7	0.82	1.13	0.00	0.04	14.48	0.00	0.00	0.00	13.37	23.98
102 SOIL 153		691.5	0.82	1.07	0.05	0.04	14.30	0.00	0.00	0.00	13.33	23.73
103 SOIL 154		707.8	0.87	1.08	0.06	0.04	14.30	0.00	0.00	0.00	13.88	24.13
104 SOIL 155		724.5	0.68	0.82	0.04	0.03	13.71	0.00	0.00	0.00	10.62	21.25
105 SOIL 156		705.2	0.51	0.88	0.00	0.02	12.32	0.00	0.00	0.00	9.39	18.94
106 SOIL 160		816.8	0.47	0.70	0.00	0.02	11.59	0.00	0.00	0.00	8.02	17.28
107 SOIL 161		758.8	0.54	1.11	0.00	0.02	15.75	0.00	0.00	0.00	11.00	23.46
108 SOIL 162		739.7	0.53	0.85	0.03	0.02	13.38	0.00	0.00	0.00	9.53	20.09

Table A-1. Gamma Spectrometry Data from Drain Line Soil Samples
(Sheet 4 of 6)

	39	40	41	42	43	44	45	46	47	48	49	50
109 SOIL 1000		800.7	0.54	0.62	0.04	0.02	10.49	0.00	0.00	0.00	8.26	16.35
110 SOIL 1001		756.6	0.67	0.68	0.00	0.03	14.14	0.00	0.00	0.00	9.49	20.95
111 SOIL 1002		807.5	0.52	0.65	0.00	0.02	14.90	0.00	0.00	0.00	8.12	20.69
112 SOIL G1		667.4	0.59	0.88	0.00	0.03	15.93	0.00	0.00	0.00	10.03	23.04
113 SOIL G2		680.9	0.61	0.86	0.00	0.03	15.78	0.00	0.00	0.00	10.04	22.90
114 SOIL G3		631.7	0.62	0.73	0.00	0.03	15.96	0.00	0.00	0.00	9.38	22.65
115 SOIL G5		573.6	0.95	0.97	0.06	0.04	18.05	0.00	0.00	0.00	13.88	27.94
116 SOIL G6		747.8	0.47	0.62	0.00	0.02	10.01	0.18	0.00	0.00	7.49	15.52
117 SOIL G7		692.2	0.61	0.80	0.00	0.03	15.44	0.00	0.00	0.00	9.71	22.35
118 SOIL G9		700.1	0.58	0.73	0.00	0.03	14.99	0.00	0.00	0.00	9.02	21.42
119 SOIL G10		677.7	0.56	0.94	0.00	0.03	15.69	0.00	0.00	0.00	10.06	22.79
120 SOIL G11		717.2	0.68	0.75	0.04	0.03	15.36	0.00	0.00	0.00	10.22	22.63
121 SOIL G13		678.9	0.65	0.86	0.03	0.03	16.35	0.00	0.00	0.00	10.54	23.82
122 SOIL G14		670.2	0.73	0.75	0.00	0.03	14.01	0.00	0.00	0.00	10.30	21.39
123 SOIL G15		689.4	0.55	0.73	0.00	0.02	14.14	0.00	0.00	0.00	8.78	20.38
124 SOIL G30		759.5	0.67	0.95	0.00	0.03	13.22	0.00	0.00	0.00	11.00	21.03
125 SOIL G31		644.4	0.83	1.36	0.05	0.04	19.15	0.00	0.00	0.00	15.14	29.79
126 SOIL G32		729.1	0.56	0.95	0.00	0.03	17.57	0.00	0.00	0.00	10.16	24.75
127 SOIL G33		603.6	0.81	1.13	0.00	0.04	17.56	0.00	0.00	0.00	13.26	26.97
128 SOIL G34		719.9	0.80	1.00	0.04	0.04	13.13	0.00	0.00	0.00	12.71	22.15
129 SOIL G35		686.2	0.78	1.10	0.05	0.03	15.94	0.00	0.00	0.00	13.19	25.25
130 SOIL G36		660.7	0.67	0.85	0.00	0.03	13.95	0.00	0.00	0.00	10.44	21.38
131 SOIL G37		696.6	0.72	0.90	0.05	0.03	15.16	0.00	0.00	0.00	11.53	23.32
132 SOIL G39		653.6	0.58	1.14	0.00	0.03	14.76	0.00	0.00	0.00	11.48	22.82
133 SOIL G40		750.8	0.58	0.99	0.00	0.03	14.00	0.00	0.00	0.00	10.58	21.47
134 SOIL G41		738.0	0.80	0.94	0.05	0.04	16.59	0.00	0.00	0.00	12.43	25.42
135 SOIL G42		643.8	0.56	0.95	0.00	0.03	17.72	0.00	0.00	0.00	10.21	24.93
136 SOIL G42		831.9	0.64	0.77	0.02	0.03	15.14	0.00	0.00	0.00	9.89	22.17
137 SOIL G43		767.0	0.71	0.90	0.00	0.03	15.12	0.00	0.00	0.00	11.07	23.00
138 SOIL G44		727.0	0.83	0.97	0.06	0.04	15.65	0.00	0.00	0.00	12.87	24.78
139 SOIL G44 DUPLICATE		768.2	0.62	0.86	0.00	0.03	15.31	0.00	0.00	0.00	10.11	22.49
140 SOIL G45		748.3	0.61	0.78	0.00	0.03	13.66	0.00	0.00	0.00	9.54	20.45
141 SOIL G45 DUPLICATE		814.3	0.72	0.86	0.00	0.03	15.43	0.00	0.00	0.00	10.91	23.21
142 SOIL G46		681.8	0.59	0.92	0.05	0.03	14.15	0.00	0.00	0.00	10.60	21.61
143 SOIL G46 DUPLICATE		806.2	0.74	0.82	0.05	0.03	14.66	0.00	0.00	0.00	11.15	22.59
144 SOIL G47		667.2	0.89	0.82	0.06	0.04	17.80	0.00	0.00	0.00	12.44	26.68

Table A-1. Gamma Spectrometry Data from Drain Line Soil Samples
(Sheet 5 of 6)

	39	40	41	42	43	44	45	46	47	48	49	50
145 SOIL G47 DUPLICATE		606.4	0.60	0.83	0.00	0.03	17.34	0.00	0.00	0.00	9.77	24.28
146 SOIL G48		768.1	0.68	0.72	0.05	0.03	15.57	0.00	0.00	0.00	10.07	22.74
147 SOIL G49		644.3	0.57	0.91	0.00	0.03	16.12	0.00	0.00	0.00	10.03	23.21
148 SOIL G50		601.5	0.80	1.06	0.06	0.04	18.09	0.00	0.00	0.00	13.20	27.42
149 SOIL G50 (60000 SECOND)		601.5	0.72	1.01	0.04	0.03	16.30	0.00	0.00	0.00	12.11	24.86
150 SOIL G51		646.6	0.60	1.08	0.00	0.03	18.11	0.00	0.00	0.00	11.32	26.08
151 SOIL G52		734.3	0.55	0.97	0.00	0.02	13.99	0.00	0.00	0.00	10.16	21.15
152 SOIL G53		711.4	0.66	0.68	0.00	0.03	14.33	0.00	0.00	0.00	9.39	21.06
153 SOIL G60		676.6	0.49	0.91	0.00	0.02	15.98	0.00	0.00	0.00	9.34	22.56
154 SOIL G61		705.5	0.50	0.81	0.00	0.02	13.45	0.00	0.00	0.00	8.90	19.74
155 SOIL G62		701.0	0.58	0.74	0.04	0.03	14.50	0.00	0.00	0.00	9.30	21.08
156 SOIL G63		754.2	0.53	0.69	0.00	0.02	14.55	0.00	0.00	0.00	8.40	20.53
157 SOIL G64		666.9	0.52	0.65	0.00	0.02	14.63	0.00	0.00	0.00	8.06	20.37
158 SOIL G65		689.0	0.43	0.65	0.00	0.02	14.36	0.00	0.00	0.00	7.30	19.53
159 SOIL G66		710.0	0.63	0.68	0.00	0.03	13.63	0.00	0.00	0.00	9.11	20.15
160 SOIL G70		790.2	0.50	0.78	0.00	0.02	13.51	0.00	0.00	0.00	8.72	19.68
161 SOIL G71		795.4	0.65	0.81	0.00	0.03	15.43	0.00	0.00	0.00	10.04	22.58
162 SOIL G72		777.1	0.59	0.76	0.00	0.03	15.15	0.00	0.00	0.00	9.28	21.76
163 SOIL G73		784.8	0.72	0.79	0.05	0.03	13.85	0.00	0.00	0.00	10.80	21.53
164 SOIL G74		798.6	0.64	0.87	0.04	0.03	13.03	0.00	0.00	0.00	10.69	20.58
165 SOIL G75		777.5	0.59	0.68	0.00	0.03	15.38	0.00	0.00	0.00	8.76	21.64
166 SOIL G78		761.1	0.56	0.80	0.00	0.03	12.49	0.00	0.00	0.00	9.25	19.05
167 SOIL G79		769.9	0.50	0.75	0.00	0.02	13.00	0.00	0.00	0.00	8.48	19.02
168 SOIL G80		792.3	0.51	0.75	0.00	0.02	12.77	0.00	0.00	0.00	8.58	18.85
169 SOIL G80 DUPLICATE		789.6	0.64	0.78	0.04	0.03	14.79	0.00	0.00	0.00	10.10	21.95
170 SOIL G81		738.8	0.59	0.77	0.00	0.03	14.86	0.00	0.00	0.00	9.30	21.47
171 SOIL G82		785.2	0.60	0.72	0.04	0.03	14.49	0.00	0.00	0.00	9.43	21.18
172 SOIL G83		767.5	0.70	0.79	0.04	0.03	14.74	0.00	0.00	0.00	10.61	22.28
173 SOIL G84		801.8	0.65	0.86	0.00	0.03	13.99	0.00	0.00	0.00	10.35	21.35
174 SOIL G85		818.7	0.74	0.62	0.04	0.03	15.10	0.00	0.00	0.00	9.93	22.23
175 SOIL G87		756.2	0.73	0.71	0.00	0.03	14.78	0.00	0.00	0.00	10.04	21.99
176 SOIL G88		785.2	0.74	0.72	0.05	0.03	11.55	0.00	0.00	0.00	10.61	19.13
177 SOIL G88 DUPLICATE		805.3	0.64	0.68	0.04	0.03	13.95	0.00	0.00	0.00	9.55	20.74
178 SOIL G89		809.1	0.60	0.73	0.00	0.03	14.75	0.00	0.00	0.00	9.14	21.26
179 SOIL G90		768.6	0.53	0.69	0.00	0.02	13.94	0.00	0.00	0.00	8.41	19.93
180 SOIL G91		853.7	0.68	0.77	0.00	0.03	14.39	0.00	0.00	0.00	10.08	21.60